[Specification]

[Title of the invention]

LEAD FRAME AND SEMI-CONDUCTOR PACKAGE ATTACHED HEAT SPREADER USING THE SAME

[Brief Description of the Drawings]

Fig. 1a is a plan view illustrating a typical structure of a conventional lead frame, Fig. 1b is a schematic view illustrating a procedure for fabricating a conventional heat sink, and Fig. 1c is a cross-sectional view illustrating a typical structure of a conventional semiconductor package fabricated using the conventional lead frame and the conventional heat sink;

Fig. 2 is a schematic plan view illustrating a lead frame according to an embodiment of the present invention;

Fig. 3 is an enlarged plan view corresponding to a portion "A" of Fig. 2;

Fig. 4 is an enlarged plan view corresponding to a portion "B" of Fig. 2;

Fig. 5 is an enlarged plan view corresponding to a portion "C" of Fig. 2;

Fig. 6a and Fig. 6b are schematic views illustrating a procedure for fabricating a heat sink according to the present invention;

Fig. 7 is a cross-sectional view illustrating a semiconductor package fabricating the use of the lead frame according to the present invention and the heat sink.

- Reference numerals -

100: A lead frame	2: A central opening
4: An inner lead	6: pseudo tie bars
7: An outer lead	8: An Ag plating line
10: A body out line	12: An encapsulating resin introduction

region

14: An air vent regions 16: A hole

200: A semiconductor package 22: A heat sink

22a: A bur 24: An adhesive tape

26: An adhesive 28: A semiconductor chip

30: A conductive wire 32: A resin encapsulate

[Detailed Description of the present invention]

[Objects of the present invention]

[Field of the invention and Background of the Invention]

The present invention relates to a lead frame and a heat sink-attached semiconductor package using a lead frame. More particularly, the present invention relates to a lead frame and a heat sink-attached semiconductor package which has been fabricated using the lead frame to obtain a smooth flow of melted encapsulating resin in a molding process, to achieve an easy fabrication, in addition, to exhibit superior heat discharge characteristics.

Typically, lead frames for semiconductor packages are fabricated by processing strips made of copper (Cu), iron (Fe), copper alloy (Cu Alloy) or its equivalent, in accordance with a mechanical method such as a stamping method or a chemical method such as an etching method in such a fashion that it has a plurality of leads. Leads made by this kind of lead frame serve as conductive lines for connecting a semiconductor chip mounted on the lead frame to external circuits. Such leads also serve as a support for holding a semiconductor package fabricated using the associated lead frame to a motherboard.

As shown in Fig. 1a, a lead frame 100', has a structure including a

central opening 2' having a substantially rectangular or square shape, and a plurality of leads extending radially around the central opening 2'. Each of the leads has an inner lead 4' and an outer lead 7' extended to the inner lead 4'. Each lead is connected to a dam bar 5' at the boundary portion between the inner lead 4' and the outer lead 7' so that it is supported by the dam bar 5'. In addition to the support function for the leads, the dam bar 5' has a function for preventing melted encapsulating resin from being exposed to the outside during a molding process. Also, pseudo tie bars 6' extends diagonally at four corners of the central opening 2', respectively. The pseudo tie bars 6' serve as tie bars for supporting the semiconductor chip mounting plate. Otherwise, the pseudo tie bars 6' may be removed to simply leave spaces, respectively. In some cases, they may be used as inner leads.

In Fig. 1a, reference numeral 12' denotes an initial encapsulating resin introduction region defined which is defined at a selected area of one of the inner leads 4' (or pseudo tie bars) respectively arranged at the four corners of the central opening 2'.

On the other hand, Fig. 1b is a schematic view illustrating a procedure for fabricating a conventional heat sink 22'. As shown in Fig. 1b, a pair of facing "_⌃_"-shaped slots 41' and 42' are formed through a metal strip 40' having a substantially rectangular or square shape in accordance with a stamping process in such a fashion that a pair of facing support bars 44' are left there between. The support bars 44' have a reduced thickness as compared to that of the metal strip 40' because the metal material of the metal strip 40' is subjected to an elongation at those regions corresponding to those support bars 44' during the stamping process. The reason that the support bars 44' are

formed is due in part to the situation when the heat sink 22' is completely cut from the metal strip 40' using a single stamping step, there is a high possibility for the heat sink 22' to be bent due to a relatively large thickness (typically, more 1 mm) of the metal strip 40'. In order to planarize bent heat sinks, it is necessary to use an additional process. After the stamping process, the heat sink 22' is still held to the metal strip 40' while being supported by the support bars 44' between the slots 41'. In this state, the support bars 44' are cut, so that the heat sink 22' is separated from the metal strip 40'. Meanwhile, the cut heat sink 22' is subsequently coated with nickel (Ni) in order to prevent its surface, which is exposed in a state integrated into a resin encapsulate, from being oxidized in air. The nickel-coated surface of the heat sink 22' is also subjected to a sand blast process for an easy marking thereof. The heat sink 22' is also subjected to a well-known black oxidation process at its surface, on which a semiconductor chip is mounted, where its surface contact the resin encapsulate, in order to obtain an improved bonding force of the resin encapsulate at those surfaces.

Fig. 1c is a cross-sectional view illustrating a typical structure of a conventional semiconductor package 200' fabricate using a lead frame such as the conventional lead frame and a heat sink such as the conventional heat sink 22'.

As shown in Fig. 1c, the semiconductor package 200', includes the heat sink 22' having a predetermined thickness located at its center. A semiconductor chip 28' integrated with a variety of circuits is bonded to the top surface of the heat sink 22' by means of an adhesive 26'. Also, the lead frame, as described above, including a plurality of inner leads 4' are attached to the

outer peripheral portion of the upper surface of the heat sink 22' by means of adhesive tapes 24'. Furthermore the inner lead 4' and the semiconductor chip 28' are connected to each other by means of a conductive wire 30', so that the signals of the semiconductor chip 28' can be transmitted to an external device through the conductive wire 30' and the inner lead 4' or the like. Also, the semiconductor package 200' includes a resin encapsulate 32' for protection of the semiconductor chip 28', inner leads 4' and heat sink 22' from the external environment. The heat sink 22' is exposed at its surface which is arranged at the lower surface side of the resin encapsulate 32' in order to obtain improved heat discharge characteristics

In the case of a semiconductor package fabricated using a conventional lead frame having both a semiconductor chip mounting plate and a heat sink, a semiconductor chip is mounted on the semiconductor chip mounting plate by means of an adhesive layer. In the fabrication of such a semiconductor package, the lead frame attached with the semiconductor chip is loaded in a mold, in a state where the heat sink has been loaded in the cavity of a lower mold included in the mold. Subsequently, a melted encapsulating resin of high temperature and high pressure is injected into the cavity of the mold and then set. In this case, one side surface (bottom surface) of the heat sink is exposed to the outside of the resin encapsulate.

In the above mentioned conventional lead frame, however, the space defined between the adjacent ones of the inner leads arranged at the initial encapsulating resin introduction region, is the same as that of the inner leads arranged at those regions other than the initial encapsulating resin introduction region, so that it is impossible to obtain a smooth flow of melted encapsulating

resin. As a result, a turbulent flow of melted encapsulating resin is generated, thereby causing the formation of voids or an incomplete forming phenomenon in the resin encapsulate.

It is also difficult to cut the conventional heat sink used in the fabrication of the conventional semiconductor package by use of a single stamping step due in part to the heat sink having a large thickness. For this reason, several stamping steps are required for the cutting of the heat sink. This results in a complexity of the entire process. The entire process becomes more complex because the heat sink is coated with nickel (Ni) in order to prevent its surface, which is exposed in a state integrated to a resin encapsulate, from being oxidized in air, and then subjected to a sand blast process for an easy marking thereof while being subjected to a well-known black oxidation process at its surface, on which a semiconductor chip is mounted to its surface contacting the resin encapsulate, in order to obtain an improved bonding force to the resin encapsulate at those surfaces. In addition, the protrusions left after the cutting of the heat sink serve to render the turbulent flow generated in a resin filling process, which is severe, thereby increasing the possibility of the formation of voids or exfoliation.

In the fabrication of the conventional semiconductor package using the conventional lead frame and the conventional heat sink, additional problems are also involved. That is, the leads of the lead frame may be downwardly bent due to the weight of the heat sink during the feeding of the lead frame due in part to a subsequent process in a state in which each inner lead is bonded to the peripheral portion of the upper surface of the heat sink. This is because the heat sink has a thickness considerably larger than that of each lead. Due to

such a deformation of the leads, a short circuit may be generated between adjacent ones of the leads. Also, the quality of the wire bonding formed between the semiconductor chip and each lead may be degraded.

In the conventional semiconductor package structure, the bottom surface of the heat sink is exposed to the outside of the resin encapsulate in order to obtain an improved heat discharge effect, thereby the mold structure becomes complicated. Moreover, it is necessary to use a deflashing process for removing a set resin thin film left on the exposed lower surface of the heat sink.

[SUBJECT MATTERS TO BE SOLVED BY THE INVENTION]

Therefore, a primary object of the invention is to provide a lead frame capable of obtaining a smooth flow of melted encapsulating resin by appropriately controlling intervals between the inner leads, thereby avoiding the formation of voids in a molding process and an incomplete forming phenomenon.

An another object of the invention is to provide a semiconductor package fabricated using a heat sink capable of achieving an easy fabrication thereof only by the stamping process and the black oxidation process and minimizing a generation of a turbulent flow of melted encapsulating resin in the molding process.

Furthermore another object of the invention is to provide a semiconductor package fabricated using a heat sink capable of preventing a bending phenomenon of leads occurring due to the weight of the heat sink by allowing the heat sink to be thin and light. Also, the semiconductor package of the present invention can be easily and simply fabricated by locating the heat sink in the resin encapsulate.

[Construction and Operation of the present invention]

In order to achieve the above objective, according to one aspect of the present invention, there is provided a lead frame comprising a central opening having a substantially rectangular or square shape at its center in order for a semiconductor chip to be located therein and a plurality of leads extending radially around the central opening toward an outline part of the body, wherein: the inner leads having a width which increases as it extends from an outline part

of the body toward the central opening, the space defined between the adjacent ones of those inner leads has been gradually reduced as they extend from an outline of the body towards the central opening, and an encapsulating resin introduction region having a width larger than the space between the inner leads is formed between one corner of the central opening and a corner of the outline part of the body corresponding to the corner of the central opening in order to allow an easy introduction of encapsulating material.

Here, preferably, the encapsulating resin introduction region has a width gradually reduced as it extends from the outline part of the body toward the central opening, in order to allow an easy introduction of encapsulating material.

Also, it is preferred that the width of the inner leads is more than about 70% of the thickness of the inner lead.

In order to achieve the above objective according to one aspect of the present invention, t here is provided a semiconductor package comprising: a heat sink of substantially rectangular or square shape having a predetermined thickness; a semiconductor chip bonded to the top surface of the heat sink by means of a nonconductive adhesive tape; a plurality of inner leads attached to the outer peripheral portion of the upper surface of the heat sink by means of adhesive tapes, each inner leads having a width increasing as they extend toward the semiconductor chip and a space defined between adjacent ones of those inner leads being gradually reduced as they extend toward the semiconductor chip; a plurality of outer leads extended to the inner leads; a conductive wire connecting the semiconductor chip and the inner leads; and an encapsulating portion formed by applying an encapsulating material to the heat sink, the semiconductor chip, the inner leads and the conductive wires.

Here, it is preferred that the heat sink has a thickness of 0.3 to 1 mm.

As is apparent from the above description, the present invention provides a lead frame capable of obtaining a smooth flow of melted encapsulating resin by appropriately controlling intervals between the inner leads, thereby avoiding the formation of voids and an incomplete forming phenomenon.

Also, the heat sink used in the semiconductor package of the present invention is fabricated only by the stamping process and the black oxidation process, so that its fabrication is relatively simple, in addition, the fabrication process of the semiconductor package is simple.

Furthermore, since the heat sink is very thin and light in comparison with the prior art, the bending phenomenon of the leads bonded to the upper surface of the heat sink can be prevented. Also, although the heat sink is located in the resin encapsulate, an improved heat discharge characteristics can be exhibited by providing the heat sink having the optimum thickness.

Reference will now be made in greater detail to a preferred embodiment of the invention, an example of which is illustrated in the accompanying drawings. Wherever possible, the same reference numerals will be used throughout the drawings and the description in order to refer to the same or those like parts.

Fig. 2 is a plan view illustrating a lead frame 100 according to the present invention, Fig. 3 is an enlarged plan view corresponding to a portion “A” of Fig. 2, Fig. 4 is an enlarged plan view corresponding to a portion “B” of Fig. 2, and Fig. 5 is an enlarged plan view corresponding to a portion “C” of Fig. 2.

For the simplicity of illustration, a heat sink 22 is bonded to a lower

surface of the lead frame 100. Also, a dam bar and outer leads extended to inner leads 4 are not shown in the drawings.

As shown in the drawings, the lead frame 100 includes a central opening 2 having a substantially rectangular or square shape formed at its center in order to support and mount a semiconductor chip on a heat sink 22. Also, the lead frame 100 includes a plurality of the inner leads 4 extending radially around the central opening 2.

The inner leads 4 have a width, which increases as they extend from an outline part of the body 10 (an encapsulating resin) toward the central opening 2. Also, the space defined between the adjacent ones of those inner leads 4 has been gradually reduced as they extend from an outline part of the body 10 towards the central opening 2.

That is, as shown in Fig. 2, in order for the encapsulating resin to easily flow out and maintain its high rate of flow ability, it is preferred that the width of the inner leads 4 located at the upper surface of the heat sink 22 is widened and the space between inner leads 4 is reduced, while the width of the inner leads 4 located at the outside of the heat sink 22 is made to be small and the space between inner leads 4 is widened.

More particularly, as shown in Fig. 2, the width p11 of the inner leads 4 located at the upper surface of the heat sink 22 is wide and the space p12 between inner leads 4 is small, while the width of the inner leads 4 located at the outside of the heat sink 22 is small and the space between inner leads 4 is wide. Also it is preferred that the width of the inner leads 4 located at the upper surface of the heat sink 22 should be more than 70% of the thickness of the lead frame 100, thereby preventing the inner leads 4 from becoming vented, the

wire bonding process can easily be performed, also it cannot be shortened with each other.

In Fig. 2, the reference numeral 8 denotes an Ag plating line in which one end of the inner leads 4 is plated with Ag in order that it is easily bonded with the conductive wire during the wire bonding process.

Meanwhile, an encapsulating resin introduction region 12 having a width larger than the space between the inner leads 4 is formed between one corner of the central opening and a corner of the out line of body 10 corresponding to the corner of the central opening in order to allow an easy introduction of the encapsulating material, without forming the inner leads 4 or pseudo tie bar which is seen as being preferable. That is, an inlet for injecting the encapsulating material is located at one end (vicinity of the outline part of body 10 of the encapsulating resin introduction region 12 in order to allow an easy introduction of encapsulating material into the mold cavity.

As shown in FIG. 3, the encapsulating resin introduction region 12 has a width or space, which is reduced as they extend from an outline part of body 10 toward the central opening 2. Here, one end of the encapsulating resin introduction region 12 is defined as a gate inlet and the other end of the encapsulating resin introduction region 12 is defined as a gate outlet. The gate inlet has a width g1, and the gate outlet has a width g2. The width g1 is larger than the width g2, thereby allowing the encapsulating resin to be easily introduced into the mold cavity. Preferably, the width g1 should not be more than 0.7 mm whereas the width g2 should not be more than 0.35 mm. Also, as described above, the width of the inner leads 4 located at the upper surface of the heat sink 22 is wide and the space between inner leads 4 is small, while the

width of the inner leads 4 located at the outside of the heat sink 22 is small and the space between inner leads 4 is wide, thereby allowing the encapsulating resin to be easily introduced into the mold cavity.

Here, where the space p12 between inner leads 4, to which the heat sink 22 is bonded through an adhesive tape 24 and the width g2 are excessively wide, the area of the adhesive tape 24 exposed to the melted encapsulating resin of a high temperature increases excessively, thereby causing the adhesive tape 24 to be melted by the melted encapsulating resin. In this case, the adhesive tape 24 may be perforated. Furthermore, voids may be formed in the molded resin encapsulate. Also, where the bonding force between the adhesive tape 24 and the encapsulating resin is poor, as described above, the exfoliation at the interface between adhesive tape 24 and the encapsulating resin may occur. In order to prevent the problem as described above, it is preferred that the space p12 between inner leads 4 and the width g2 should be less than 0.35 mm.

Meanwhile, pseudo tie bars 6 (conventionally, a tie bar serves to support a chip mounting board) are arranged from the remaining corners of the central opening 2 except for the encapsulating resin introduction region 12 to the outline of the body 10. Preferably, the pseudo tie bar 6 has a width less than two times the width of lead frame 100. Air vent regions 14 are formed at the ends (vicinity of the out line of body 10) of the pseudo tie bars 6 in order to discharge air compression, which occurs by the encapsulating resin to the outside in the encapsulating process. Actually, the air vents are formed in the mold and located at the air vent regions 14 of the lead frame 100.

As shown in Fig. 4, it is preferred that a width g3 and a width g4 are at

least 0.2 mm and a width g5 is at least 0.15 mm. Accordingly, it is possible to more effective by obtaining the effects of allowing the melted encapsulating resin to easily reach the outline part of the body 10 while allowing the air existing in the mold cavity to be easily vented from the mold cavity. Also, as shown in Fig. 5, at least one hole 16 is formed at the pseudo tie bar 6 what is arranged at a selected area of the air vent regions 14. The hole 16 serves to prevent the associated pseudo tie bar 6 from being mis-aligned and to also distinguish information about the fabrication process, which is applied to the associated lead frame 100. Here, it is preferred that a width of the hole 16 is less that 0.20mm. Also, as shown in Fig. 5, it is preferred that a width v1 and a width v2 should be at least 0.20 mm and a width v3 and a width v4 should be at least 0.15 mm.

Fig. 6a and Fig. 6b are schematic views illustrating a procedure for fabricating the heat sink 22 used in a semiconductor package according to the present invention.

As shown in the Fig. 6a, the heat sink 22 is fabricated in order to have a square shape by forming a slot 42 having a square loop shape through a rectangular metal plate strip 40, which has a thickness of about 0.5 mm in accordance with a stamping process involving a single stamping step. The reason why the heat sink 22 can be fabricated using a single stamping step is because the thin metal plate strip 40 that is used has a thickness which is considerably smaller than the thickness used in the conventional cases.

When the heat sink 22 is downwardly punched in accordance with the stamping process, it may be formed with burs 22a extending downwardly from the peripheral edge of its lower surface. The inner lead 4 of the lead frame 100

is bonded to the upper surface of the heat sink 22 which is opposite to the lower surface of the heat sink 22 at which the burs 22a is formed, thereby preventing a short-circuit of the inner lead 4 or perforation of the adhesive tape 24. Meanwhile, it is desirable to this process that the surface of the heat sink 22 should use a well-known black oxidation process in order to obtain an improved bonding force to the molded resin encapsulate.

Fig. 7 is a cross-sectional view illustrating a semiconductor package 200 fabricated using the lead frame 100 according to the present invention and the heat sink 22.

As shown in Fig. 7, the semiconductor package 200, includes the heat sink 22 having a thickness of approximately 0.5 mm, which is substantially more of a rectangular or square shape, which is located at its center. A semiconductor chip 28 is bonded to the top surface of the heat sink 22 by means of an adhesive 26. Also, the burs 22a are formed at the bottom surface of the heat sink 22. Here, the heat sink 22a is located at the surface opposed to the semiconductor chip 28 and the lead frame 100, so that a short-circuit of the inner lead 4 or perforation of the adhesive tape 24 can be prevented. Moreover, the inner leads 4 is attached to the outer peripheral portion of the upper surface of the heat sink 22 by means of the adhesive tape 24. Here, the width of the inner leads 4 is gradually increased and the space defined between adjacent those being adjacent in the inner leads 4 are gradually reduced as they extend toward the semiconductor chip 28. A plurality of outer leads 7 are extended to the inner lead 4 in order that they be mounted on a mother board. Furthermore, the inner lead 4 and the semiconductor chip 28 are connected to each other by means of a conductive wire 30 such as a gold wire. The

semiconductor package 200 also includes a resin encapsulate 32 used for protecting the semiconductor chip 28, inner leads 4 and heat sink 22 from the external environment.

The results of a measurement of values of θ_{JA} (°C/W) depicting a variation in heat discharge effect depending on the thickness of the heat sink 22 are as following table 1.

□Table 1□

thickness of the heat sink (mm)	$\square_{JA}(\square/W)$
0.1	14.77
0.2	12.99
0.3	12.28
0.4	11.89
0.5	11.64
0.6	11.47
0.7	11.35
0.8	11.25
0.9	11.17
1.0	11.11

In a quad flat semiconductor packages having a size of 28 mm x 28 mm and a number of leads corresponding to 208, it can be found that a remarkable decrease in the value of θ_{JA} (°C/W) is exhibited within a heat sink thickness range from 0.1 mm to 0.5 mm. It is also found that the decrease rate of the value of θ_{JA} (°C/W) is low with a heat sink thickness of more than 0.5 mm.

As a result of a molding experiment conducted in association with the case in which the heat sink 22 is completely encapsulated by a molded resin encapsulate, it was found that there is a tendency for voids to be formed at the central portion of the lower surface of a semiconductor package, finally

produced, where the heat sink 22 has a thickness of no less than 1.0 mm. It was also found that where the heat sink 22 has a thickness of no more than 1.0 mm, there is a tendency for voids to be formed at a portion of the lower surface of the semiconductor package 200 extending from the edge of the lead frame opposite to the initial encapsulating resin introduction region 12. It was also found that when the heat sink 22 has a thickness of about 0.50 mm, none or little formation of voids occurs.

Therefore, according to the lead frame of the present invention, the width of the inner leads located at the upper surface of the heat sink is wide and the space between the inner leads is small, while the width of the inner leads located at the outside of the heat sink is small and the space between inner leads is wide and the width of the initial encapsulating resin introduction region is larger than that of the inner lead, thereby obtaining a smooth flow of melted encapsulating resin, resulting in the prevention of the void or exfoliation.

Also, since the heat sink used in the semiconductor package according to the present invention is very thin in comparison with the prior art, only the stamping process and the black oxidation process can fabricate it, so that its fabrication is relatively simple, in addition, the fabrication process of the semiconductor package is simple.

Furthermore, since the heat sink is very thin and light in comparison with the prior art, the bending phenomenon of the leads bonded to the upper surface of the heat sink can be prevented. Also, although the heat sink is located in the resin encapsulate, an improved heat discharge characteristics can be exhibited by providing the heat sink having a thickness of about 0.5mm.

Although the preferred embodiments of the invention have been

disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

[Effect of the present invention]

As apparent from the above description, the present invention provides a lead frame capable of obtaining a smooth flow of melted encapsulating resin by appropriately controlling intervals between inner leads, thereby avoiding formation of voids and exfoliation in the molding process.

Also, the heat sink used in the semiconductor package of the present invention is fabricated only by the stamping process and the black oxidation process, so that its fabrication is relatively simple, in addition, the fabrication process of the semiconductor package is simple.

Furthermore, since the heat sink is very thin and light in comparison with the prior art, the bending phenomenon of the leads bonded to the upper surface of the heat sink can be prevented. Also, although the heat sink is located in the resin encapsulate, an improved heat discharge characteristics can be exhibited by providing the heat sink having the optimum thickness.

[WHAT IS CLAIMED IS]

[Claim 1]

A lead frame comprising a central opening having a substantially rectangular or square shape at its center in order for a semiconductor chip to be located therein and a plurality of inner leads extending radially around the central opening toward an outline of the body, wherein:

the inner leads have a width which increases as they extend from an outline of the body toward the central opening, the space defined between adjacent ones of those inner leads has been gradually reduced as they extend from an outline of the body toward the central opening, and an encapsulating resin introduction region having a width larger than the space between the inner leads which is formed between one corner of the central opening and a corner of the outline of the body corresponding to the corner of the central opening in order to allow an easy introduction of encapsulating material.

[Claim 2]

The lead frame of claim 1, wherein the encapsulating resin introduction region has a width which is gradually reduced as it extends from the outline of the body toward the central opening, in order to allow an easy introduction of the encapsulating material.

[Claim 3]

A semiconductor package comprising:

a heat sink of substantially rectangular or square shape having a predetermined thickness;

a semiconductor chip bonded to the center of the top surface of the heat sink by means of an adhesive;

a plurality of inner leads attached to the outer peripheral portion of the upper surface of the heat sink by means of adhesive tapes, each inner leads having a width which increases as they extend toward the semiconductor chip and a space defined between the adjacent ones of those inner leads being gradually reduced as they extend toward the semiconductor chip;

a plurality of outer leads extended to the inner leads;

a conductive wire connecting the semiconductor chip and the inner leads;

an encapsulating portion formed by applying an encapsulating material to the heat sink, the semiconductor chip, the inner leads and the conductive wires.

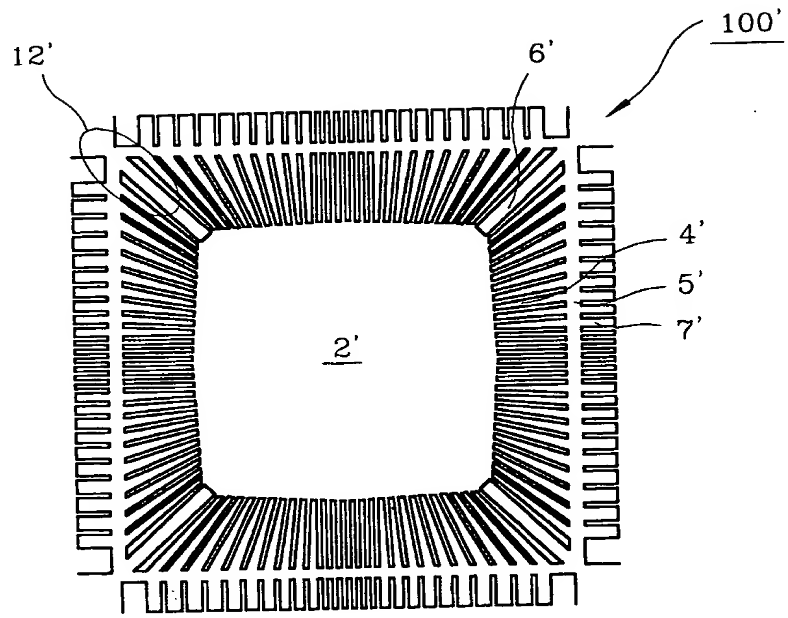
[Claim 4]

The semiconductor package of claim 2, wherein the heat sink has a thickness of 0.3 to 1 mm.

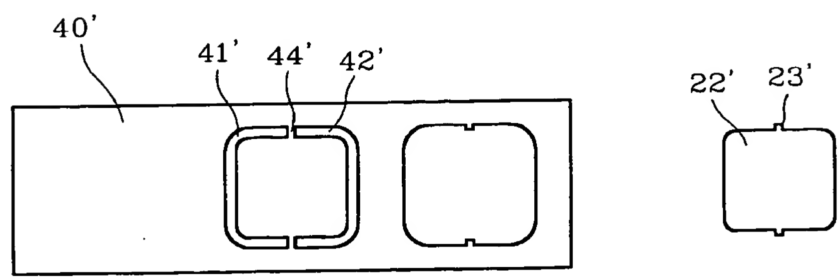
[Claim 5]

The semiconductor package of claim 2, wherein the heat sink is subjected to a black oxidation process at its surface.

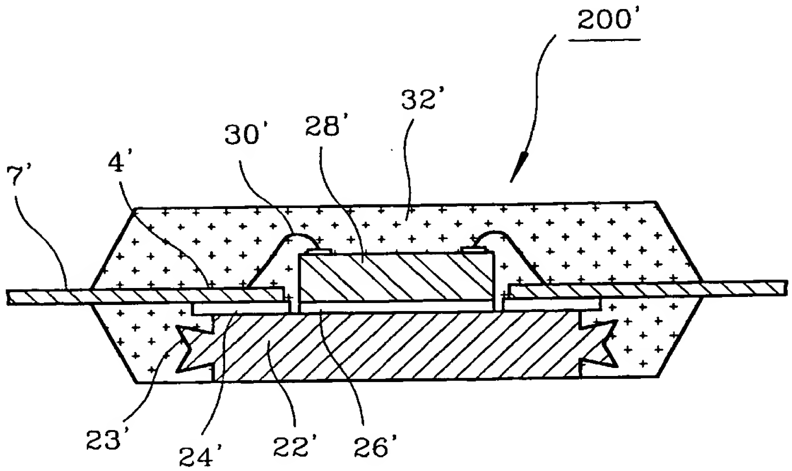
[Fig. 1a]



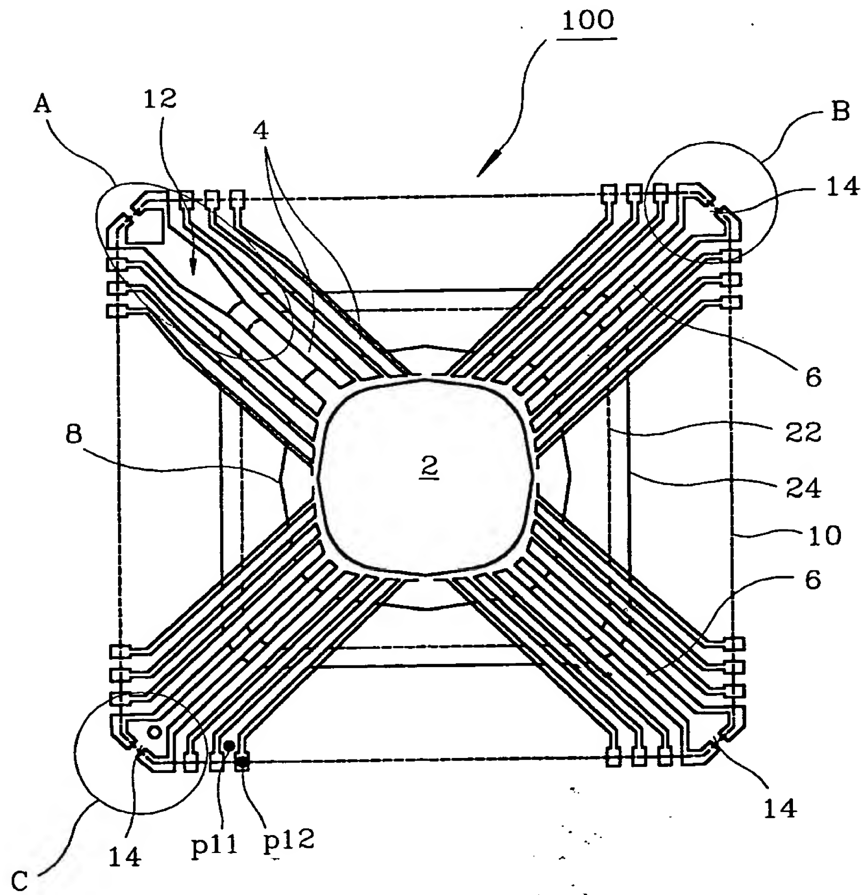
[Fig. 1b]



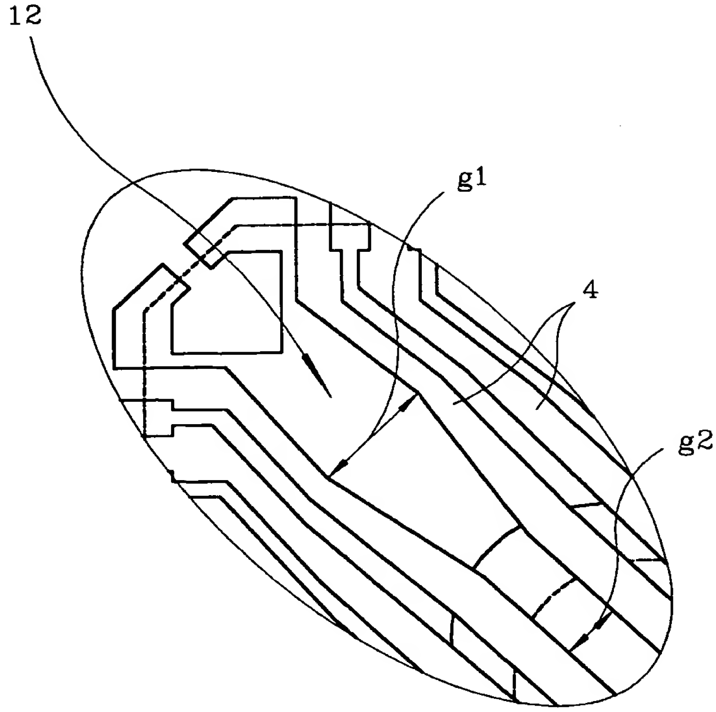
[Fig. 1c]


200'
32'
30'
28'
4'
7'
23'
24'
22'
26'

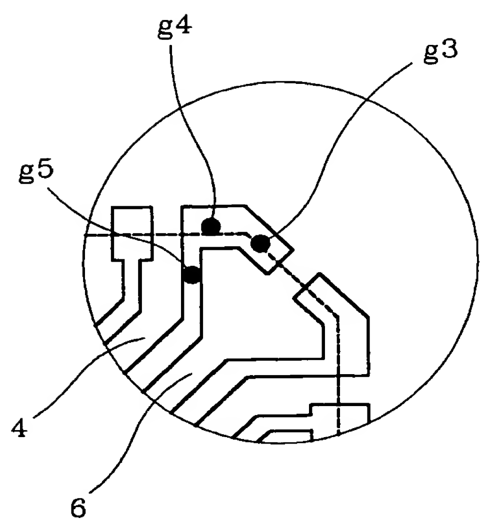
[Fig. 2]


100
A
12
4
B
14
6
8
2
22
24
10
6
14
C
14
p11
p12

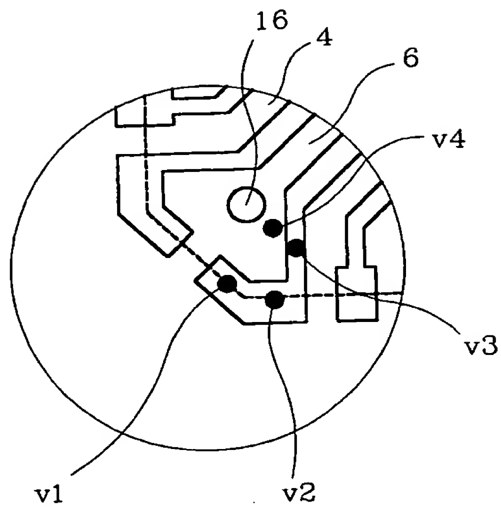
[Fig. 3]



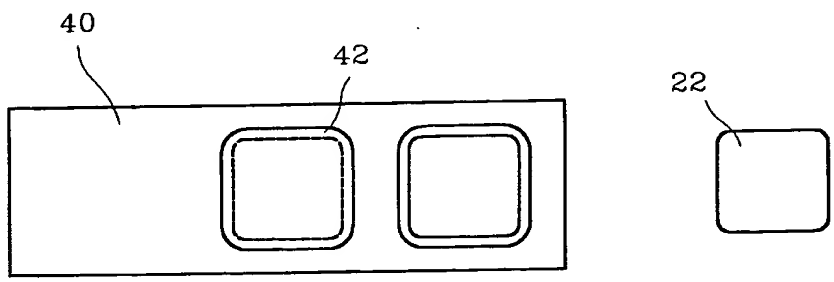
[Fig. 4]



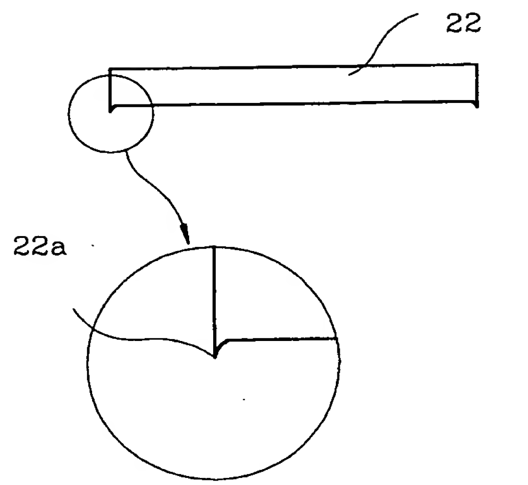
[Fig. 5]



[Fig. 6a]



[Fig. 6b]



[Fig. 7]